

Patent

#### HEADREST LINKAGE

##### Background of the Invention

The present invention relates generally to adjustable medical equipment and, more specifically, to an adjustable head support and support arm for an adjustable table.

During many examination procedures, the patient's head and neck may be repositioned if a different area of the neck or head is to be examined. If repositioning is necessary, the movement is preferably done with as little discomfort to the patient as possible. Likewise, such repositioning should be performed easily by the medical examiner.

Generally, a headrest is coupled to an extended arm that is mounted or attached to an examination table or chair. The arm typically has two or three adjustable sections, and the headrest may also be adjustable. Locking devices, such as screws, bolts, or plunger elements, have been utilized to hold the arm sections in place. However, such devices generally are cumbersome and do not afford the headrest any resistance when removed or released from the locking section.

For instance, an examiner may wish to adjust a headrest while the headrest is still supporting a patient's head. In such instances, release of the prior

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art locking devices completely releases support for the patient and may possibly injure the patient. Likewise, an examiner's fingers are easily pinched within these moving parts. Though the devices may be easily  
5 manipulated, safety may be compromised to achieve such manipulation.

#### **Summary of the Invention**

The present invention provides a linkage assembly comprised of adjustable linkage mechanisms for a  
10 headrest or other supported object. The assembly is comprised of rotatably movable arm sections connected in an end-to-end manner, with adjoining arm sections of the assembly pivoting around a supporting shaft. The arms are in a releasable interlocking relationship relative to  
15 one another. The rotatability of the adjoining arms is controlled by a handle attached to the shaft, which allows the user to interlock or disengage the adjoining arm sections and allows or prevents the arm sections from movement respective to one another. The design provides  
20 that each pivotable linkage mechanism of the assembly is independently controlled with respect to the other linkage mechanisms. Thus, adjustment of an individual linkage mechanism and corresponding arms is possible without needing to move the headrest section or other arm  
25 sections, and adjustment of the headrest section does not require movement of the arm sections.

The linkage mechanism comprises the supporting shaft that supports interacting elements that allow smooth adjustment of the mechanism. The shaft provides  
30 support for, among other elements, a friction disk, springs, and washers that provide pivotal movement and resistance for the arm sections to insure minimal injury or risk to the patient or examiner. The shaft also supports biasing means for disengaging the adjoining arms  
35 when the handle is in an open position. When the handle

is moved to a closed position, the arms have meshing teeth that allow the arm sections to be held securely and firmly in place when the handle is in a closed or locked position. Though the teeth are free from each other when  
5 the handle is in an open position, the linkage mechanism is designed in such a fashion that the arms will retain their positions unless an outside force is provided on the arm.

**Brief Description of the Drawings**

10 Figure 1 shows a sectional perspective view of the present invention attached to an adjustable headrest on an examination table.

Figure 2 is an overhead view of an adjustable arm utilizing the present invention.

15 Figure 3 is a side view of the arm shown in Figure 2.

Figure 4 is an exploded perspective view of the present invention.

20 Figure 5 is a cross-sectional view of the present invention.

Figure 6 is a cross-sectional view of the present invention in an unlocked position.

Figure 7 is a cross-sectional view of the present invention in a locked position.

25 Figure 8 is a sectional perspective view of the handle area of the present invention.

Figure 9 is a perspective view of the biasing means of the present invention.

**Description of the Preferred Embodiment**

30 Although the disclosure hereof is detailed and exact to enable those skilled in the art to practice the invention, the physical embodiments herein disclosed merely exemplify the invention which may be embodied in other specific structure. While the preferred embodiment  
35 has been described, the details may be changed without

departing from the invention, which is defined by the claims.

Figure 1 shows a perspective sectional view of an examination table 10. The examination table 10 comprises a headrest 12, which is connected to the examination table 10 by a series of rotatably adjoined arms 14a, 14b, and 14c. The present invention comprises a linkage mechanism 16 that allows the arms 14a-14c to be rotatably connected to one another and also to the examination table 10 and the headrest 12. The linkage mechanisms 16 allow the headrest 12 to be secured in a wide array of angles and positions relative to the examination table 10. It should be noted that the arms 14a-14c may be referred periodically throughout the specification as the arms 14. This is for clarification purposes in showing that the linkage mechanism 16 may be used between any two adjoining sections.

Referring to Figure 2, the assembled arms 14a-14c and linkage mechanisms 16 are shown from an overhead view. Each of the linkage mechanisms 16 has a handle 18 that allows each set of connected arms 14 to be individually locked in place. As shown in Figure 2, the handle 18 located at the end of the arm 14c that is distal to the arm 14b is shown in an open position, while the two other handles 18 in Figure 2 are shown in a closed position. Thus, only the linkage mechanism 16 associated with open handle 18 will rotate, which allows for easier and safer adjustment of the arms 14 over prior art assemblies. Again referring to Figure 2, the arms 14 and the linkage mechanisms 16 are designed so that they are preferably axially aligned. That is, the arms 14a, 14b, and 14c are all aligned lengthwise from one another so that the arms 14 will be centered from the examination table 10 to the headrest 12. However, it is not necessary for the sections to be aligned in such a

fashion to practice the present invention.

Figure 3 shows the arms 14 and the linkages 16 from a side view. The handles 18 are designed in such a manner so that they do not interfere with a patient's neck or back when in either the open or closed positions. For instance, the handle 18 in the open position, as previously noted above with respect to Figure 2, will not interfere with a patient (not shown) if the patient was resting on the headrest 12. The handles 18, when in a closed position, lie relatively along the elongated axis of the arms 14 so as to further ensure the handles 18 will not interfere with a supported patient. Preferably, the handles 18 are approximately 12° off center of the central axis of the arms 14, but any relative positioning of the handles 18 with respect to the arms 14 will fall within the scope of the invention.

Figure 4 is an exploded perspective view of the linkage mechanism 16. The handle 18 is pivotably connected to a shaft 20 by a pin 22 that slides through aligned holes in the handle 18 and the shaft 20. A notch 24 is located on the shaft 20 to prevent the shaft 20 from interfering with the pivotal movement of the handle 18. The notch 24 provides the needed clearance area for pivoting of the handle 18 when the handle 18 is in a fully open position (see, in Figures 2 and 3, the position of the handle 18 between the arm 14c and the headrest 12). The shaft 20 further has a threaded portion 26 for securing a fastener onto the shaft 20, thereby holding the linkage mechanism 16 components in place, and forming the main support for the linkage mechanism 16.

The shaft 20 slides through an opening 27 located in the center of a pivot cap 28. The pivot cap 28 provides an area for the handle 18 to pivot against when closing the linkage mechanism 16. When the handle 18

is in a closed position, the pressure of the handle 18 pressing against the pivot cap 28 will cause the linkage mechanism 16 to compress and consequently lock the linkage mechanism 16 in place. The shaft 20 then slides through a threaded collar 30 having a threaded portion 31, and the arm 14a. To make sure the handle 18 and the shaft 20 do not unnecessarily rotate, the pivot cap 28 has a plurality of tabs 32 that mate with an equal number of holes 34 located in the arm 14. Likewise, a head 36 located on the threaded collar 30 is designed to be of the same shape as a polygonal section 39 of an aperture 38 located on the arm 14a, thus allowing the collar 30 and the arm 14a to be matingly secured. While the head 36 and the polygonal section 38 are shown to be hexagonal in shape, any shape or arrangement that allows the collar 30 and the arm 14a to be fittingly secured with one another is acceptable.

Still referring to Figure 4, the shaft 20 and the collar 30 slide through the aperture 38 and through a washer 40, a friction disc 42 and another washer 40. The friction disc 42 provides resistance so that the arms 14a and 14b may still retain their positions with respect to one another even if the handle 18 is in an open position and the arms 14a and 14b are not locked together. The friction disc 42 is made of a solid material, such as a solid nylon material. More or fewer of the washers 40 may be used. Once the shaft 20 and the collar 30 pass the disc 42 and the washers 40, they will slide through a spring washer 44 and a locking nut 46. The inside of the locking nut 46 is threaded and mates with the threaded portion 31 of the collar 30. The spring washer 44 and the locking nut 46 allow for adjustment of the friction disc 42 resistance. The resistance of the friction disc 42 will increase proportionally with how far the locking nut 46 is threaded onto the collar 30.

After passing through the locking nut 46, the shaft 20 continues through a hardened washer 48, a spring 50 and one or more hardened washers 48. The shaft passes through the arm 14b, a pair of spring washers 52 and an end nut 54. The spring 50 and the spring washers 52 provide biasing means for the linkage assembly 16. When the handle 18 is in an open position, the spring 50 and the washers 52 bias the arms 14a and 14b away from one another so that the arms 14a and 14b may be adjusted. The end nut 54 is threaded onto the threaded portion 26 of the shaft 20 and allows the possible torque applied by the handle 18 to be increased or decreased. The number of hardened washers 48 and the number of spring washers 52 may be increased or decreased depending on the specifications of the user and, also, the actual dimensions of the linkage mechanism 16. An end cap 56 is fitted to the end of the second arm 14 to hide the end nut 54.

Figure 5 shows a cross-sectional view of the linkage mechanism 16 described in Figure 4 taken along line 5 - 5 of Figure 3. The linkage mechanism 16 and the handle 18 are in a closed or compressed position. The arms 14a and 14b are meshed, preventing the linkage mechanism 16 from pivoting or rotating. The handle 18 sits within the pivot cap 28, which provides resistance for the handle to pivot against. The cap 28 also has a cutout area 58 that will partially house the head 36 of the threaded collar 30. The cutout area 58, while not necessary, allows for a shallower polygonal section 39, which necessitates less tooling when manufacturing the arms 14.

The cross-sectional view of Figure 5 shows the interaction of the friction disc 42 and accompanying washers 40 with the linkage mechanism 16, and specifically with the arm 14a. The friction disc 42 has

a plurality of protrusions 60 (see Figure 4) that fit within mating slits 62 located in the arm 14b. The protrusions 60 prevent the disc 42 from rotating when the shaft 20 and the collar 30 are rotated. The washers 40 are keyed to fit into a slot 64 located on the collar 30, thereby preventing the washers from rotating if the friction disc 42 rotates with the arm 14b. As previously noted, the locking nut 46 provides and controls the resistance of the friction disc 42. The linkage mechanism 16 is preferably designed so that the friction disc 42 always gives at least some resistance.

Figure 6 shows a cross-sectional view of the linkage mechanism 16 in an open position taken along the line 6 - 6 of Figure 3. The arms 14a and 14b each have an inner facing surface 66 that include a plurality of teeth 68. In an open position, the teeth 68 of the arm 14a are free from the teeth 68 of the arm 14b so that when an outside force is applied to the arms 14a and 14b, they are free to rotate.

Figure 7 shows a cross-sectional view of the linkage mechanism 16 in a closed position taken along line 7 - 7 of Figure 3. The teeth 68 of the arms 14a and 14b are now meshed together, preventing either arm 14a or 14b to move relative to the other arm 14b or 14a, even if an outside force is applied to the arms 14a and 14b. Other locking mechanisms may be employed to lock the two arms 14a and 14b together. However, the meshing teeth 68 are preferred, as they solidly secure the arms 14a and 14b together, while allowing for multiple relative positions of the arms 14a and 14b. Similarly, the arms 14 may be manufactured from any solid material that will prevent the meshing teeth 68 from shearing if an outside is applied while the arms 14 are in a closed or locked position.

Figure 8 shows the handle 18 in more detail.



The handle 18 has an end 70 that is eccentric, which allows for over center movement of the handle 18. When the handle 18 is moved outward to an open position (shown in phantom), the end 70 will not be resting on the pivot cap 28, thereby releasing tension from the linkage mechanism 16 (see Figure 6). When the handle 18 is moved inward to a closed position, the end 70 pushes down on the pivot cap 28, which compresses the linkage mechanism 16 (see Figure 7). As shown in Figure 7, the teeth 68 are forced into the mating position and lock the arms 14a and 14b securely into place. The eccentric shape of the end 70 allows the pivot cap 28 to be firmly compressed until the handle 18 is released to an open position. An indentation 72 on the handle 18 allows the handle to sit in the closed position without interfering with the shaft 20 (see Figures 4 and 5).

The handle 18 is preferably designed so that it will be pivotally connected to the shaft 20 and the linkage mechanism 16. However, any handle design that will force the linkage mechanism 16 to compress the arms 14a and 14b. For instance the handle 18 may be designed as a clamp, a solenoid, a suction seal, or any other means of providing a force to compress the arms 14.

Figure 9 shows the spring washers 52 in detail. The washers 52, preferably Belleville washers, sit next to each other in an opposing fashion, as shown in Figures 5, 6, and 7. The concave sides of the washers 52 face each other. Such an arrangement increases the compression ability of the linkage mechanism 16, which allows use of a smaller spring 50 (see Figure 5). When the washers 52 are compressed, they are less than the height of the teeth 68 located on the arms 14, thereby preventing the teeth 68 from ratcheting. To insure the washers 52 perform properly, they should not be compressed more than about 90% from their original shape.

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As previously mentioned, the arms 14 are not of any necessary configuration. For instance in Figure 1 the headrest 12 is connected to the arm 14c by the linkage mechanism. It should be understood that in this  
5 instance the headrest 12 would fall within the scope of an arm 14, since the linkage mechanism 16 between the arm 14c and the headrest 12 works in the same manner as described between two separate arms 14.

The foregoing is considered as illustrative  
10 only of the principles of the invention. Furthermore, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described. While the preferred  
15 embodiment has been described, the details may be changed without departing from the invention, which is defined by the claims.